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Nudging à la carte: A field experiment on climate friendly food choice¹

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Abstract

Global food consumption threatens climate stability and ecosystem resilience. Because hard regulation of food choice through taxes and bans is politically difficult, behavioral approaches provide a promising alternative, given that they influence food choice to a meaningful extent. We test the effect of framing of a menu on the choice of ordering climate-friendly dishes in a randomized controlled experiment. Rearranging the menu in favor of vegetarian food had a large and significant effect on the willingness to order a vegetarian dish instead of meat. Our results demonstrate that small, inexpensive interventions can be used toward decreasing carbon emissions from food consumption.

JEL classification: D12, Q50, C93

Keywords: nudging, field experiment, decision heuristics, food choice

Abstract

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1. Introduction

In order to keep global warming close to the politically set goal of 1.5 degrees Celsius compared to pre-industrial times, immediate and far-reaching measures to reduce greenhouse gas (GHG) emissions need to be implemented. Several studies conclude that a change towards more plant-based diets can significantly reduce GHG emissions from food consumption (Bryngelsson et al., 2016; Springmann et al., 2016; Westhoek et al., 2014, Tilman and Clark, 2014). In a recent paper, Springmann et al. (2018) estimate that changes in dietary patterns reducing the consumption of animal products can reduce GHG by approximately 29 to 56 percent, depending on the targeted diet. However, there are currently no policy instruments in place that aim to initiate such changes. Meat taxes have been discussed in the scientific community (Säll and Gren, 2015; Wirsenius et al., 2011) but not implemented in any country yet. Forced choice restrictions such as *mandatory* vegetarian days in school and cafeterias entail the risk of causing psychological reactance and, ultimately, backlash (Lombardini and Lankoski, 2013).

Our paper contributes to the discussion on how to reduce climate emissions from food consumption by testing a behavioral approach in the form of a simple nudge aimed at increasing the consumption of vegetarian food at a lunch restaurant. A nudge (Thaler and Sunstein, 2008) describes an intervention that neither change prices, choices, or the information that is given in order to influence decision such as what to have for lunch. While there is evidence that nudging can push people toward making healthier food choices under some circumstances (Ellison et al., 2014; Just, 2009; Wansink, 2004; Wansink and Hanks, 2013; Wisdom et al., 2010), the evidence on the effectiveness of nudges for promoting sustainable food choices is limited. Our study is one of the first to test whether a behavioral intervention can be used to increase the consumption of vegetarian food. A related study by Kurz (2018) found that changing the order of the menu by putting the vegetarian option first can significantly increase the share of vege-

tarian dishes sold. This study supports the findings by Kurz (2018) in an even cleaner experimental design. Instead of a controlled before-after study, this paper presents a randomized controlled trial to rule out confounding factors. Moreover, while the sample in Kurz (2018) mostly consisted of students and university employees, this experiment took place in a public restaurant.

Whether behavioral approaches can be fruitful in this setting depends strongly on how malleable consumption preferences of the consumers are. We conducted a field experiment with a restaurant to test whether changing the convenience of ordering the meat dish changes the ordering behavior of the restaurant's patrons. Over the course of three weeks, customers entering the restaurant were randomly presented with one of two menus. One menu offered a meat dish and a fish dish, with a note that a vegetarian option was available on request. The other menu offered a vegetarian dish and a fish dish, with a note that a meat dish was available on request. The results show how a small change in the framing of different options can have a substantial impact on the choices individuals make. The vegetarian and fish menu resulted in 25 percent lower sales of the meat dish than the meat and fish menu.

Our intervention is closely related to an experiment conducted by Wisdom et al. (2010) regarding sandwich choices in a fast-food restaurant. In their experiment, a set of unhealthy sandwiches was made less convenient to order either by putting them on a menu that was placed in a sealed folder or by listing them on a separate page from a set of "featured" sandwiches serving as an implicit default. The authors find that both interventions affected sandwich choice, with the first one (sealing parts of the menu) having a larger effect. The benefit of our study compared with that of Wisdom and colleagues is that in our experiment, customers were not aware that they were taking part in a study. We can thus be certain that the choices observed were not affected by experimenter demand effects. Moreover, we explicitly test whether such a convenience intervention can also be used to reduce meat consumption. Previous experimental results

indicate that strong preferences for a good can impair the effect of nudges in the food domain. Wansink and Just (2016) find that children opt-out of a healthy default side dish (apple slices) when they have strong preferences for the alternative option (french fries). Similarly, Wijk et al. (2016) find no effect of a nudge on the purchases of whole-grain compared to white bread, and identify strong preferences for white bread as one potential reason for their result. Testing if nudging can reduce meat consumption in a restaurant environment where customers before the intervention mainly order dishes based on meat and fish is an important contribution to the discussion if nudges also work in settings with strong consumer preferences.

We find that a small decrease in the convenience of ordering the meat option, by making it necessary to ask the waiter to describe the dish, resulted in a significant decrease in the share of dishes containing meat sold at lunch and an increase in the shares of both vegetarian and fish dishes sold. The share of meat dishes sold decreased from an average of 47 percent before the intervention to around 21 percent in the treatment condition, where it was not directly displayed on the menu. This indicates that there is potential for restaurants to decrease the meat intensity of their dishes offered without banning meat items altogether or changing prices. We also find that the treatment effect declines over the three weeks the intervention was in place, indicating that there is need to evaluate nudging interventions over longer time periods to determine their effectiveness.

The paper continues as follows. Section 2 presents the experimental design. In section 3, we discuss possible channels through which the intervention might influence behavior. Section 4 presents the data and the experimental results. Section 5 concludes.

2. Experimental design

The experiment was conducted for three weeks in May 2016 at a restaurant located in Gothenburg, Sweden. During the evening and on weekends, food is served à la carte, but on

weekdays, a daily changing lunch menu is available for two hours. Each day, the kitchen prepares two dishes for lunch: one containing meat and one with fish. On request, the kitchen also will prepare a vegetarian meal. All dishes include salad, bread and tap water. Menus change every week and always cost 110 SEK (approximately US\$13), which puts it in the medium-priced category for Gothenburg restaurants according to the TripAdvisor website. On the restaurant's website, the food is described as "modern with tastes from around the world". The meat and fish options were approximately equally popular before our experiment started. The restaurant is frequented mainly by white-collar employees who work in the service sector and the arts, as the restaurant is located in the city center close to a major museum, a concert hall, and a library. It has 52 seats and space for a handful of people at the bar. Our experimental treatments make use of two specific features of the restaurant setup: the architecture of the restaurant and the design of the lunch menu.

Regarding architecture, the restaurant has two areas, which are separated partly by a wall and partly by a bar acting almost as a physical border (see appendix Figure A.1). The front part, where customers enter, has 30 seats. The back area has 22 seats. The lunch menu is printed each week on A3 coated paperboard and lists the options for the whole week. Proceedings during our experiment were as follows: On arrival, customers were seated by a waiter. Regular customers were seated at their regular tables as much as possible. The definition of a regular customer relies on that a waiter recognizes a guest as visiting the restaurant frequently and periodically. According to staff, the average visiting frequency of regulars is once or twice a week. Non-regulars were seated according to the size of the group. If there were several free tables, the waiter pointed out one possibility in the front and one in the back from which the customers could choose.² Once a customer or group of customers was seated, the waiter handed out the menus.

² As the restaurant has only 52 seats at 20 tables, which can be grouped together for more than two people, and it is quite busy during lunch, there is not much flexibility in seating the guests.

No menus are set up at the wall, at the entrance, or outside the restaurant. Our treatments built on this by letting the waiters hand out different menus to customers seated in the front area versus customers seated in the back. If customers wanted to have a look at the menu before deciding whether to eat at the restaurant, a waiter would give them a menu sheet from the bar. During the experiment, this was always the vegetarian and fish menu. Consequently, customers who wanted to have a look at the menu first were seated in the (slightly bigger) front area. We can rule out that any customers self-selected out of the experiment, as the waiters assured us that no guests left the restaurant after having looked at the menu.

Before the start of our experiment, the weekly lunch menu listed only the options containing meat and fish. A vegetarian dish was available on request and could be customized to a vegan version. Nowhere on the original menu, which was distributed throughout the whole restaurant, was it stated that a vegetarian or vegan dish was available. We collected weekly sales data on the number of vegetarian, meat, and fish dishes sold at lunch for four weeks before our intervention.³

During the intervention, the waiters handed out two different menus at the restaurant. One menu contained, as before, the daily meat and fish options for the whole week, but it had an additional sentence stating, “A vegetarian option is available on request.” We added this sentence to test whether simply giving information about availability could increase the sales of vegetarian dishes. Customers seated in the back part of the restaurant received this menu. The menu distributed to customers seated in the front differed by listing the daily vegetarian and fish dishes but not the meat dish. Comparably to the menu distributed in the back, we added a sentence stating, “An option containing meat is available on request.” Thus the menu distributed in the front made it slightly less convenient to order the meat dish. Customers had to summon

³ It should be stressed that no modifications were made to the menu during those four weeks; it remained the same as during the restaurant’s previous operations. The restaurant’s menu had listed only two dishes for a long time, although a vegetarian option was available by special request.

a waiter and ask what the meat dish was to be able to consider it along with the options spelled out on the menu. On the other hand, the convenience of ordering the vegetarian dish increased for those customers seated in the front, compared with the setup before the experimental period and in the back part of the restaurant during the experiment. The convenience of ordering the fish dish remained the same across periods and areas. On both menus, the fish was the second dish presented on the menu. Consequently, the vegetarian and the meat dishes were presented in the same spot. For simplicity, the vegetarian dish was usually the same as the meat dish except that the meat was replaced by a vegetable, grain, or plant protein. An advantage of this setup is that other ingredients would not affect choice and would have a similar climate impact.

The intervention lasted for three weeks, during which we collected daily sales data of the three lunch options by area, front and back. One advantage of the experimental design is that we have two control periods available. The pre-experimental period mainly serves as a control to check whether the behavior of the customers seated in the back part of the restaurant changed during the experimental period. If so, it indicates that even just adding information on the availability of a vegetarian dish can affect behavior. For evaluating the effect of making the meat less convenient to order, data from the back part of the restaurant served as the control during the intervention period. The control and treatment groups of customers were subject to the same dishes available and to the same external factors, such as weather conditions, holidays, and other daily variations, which could otherwise act as confounding factors. A major advantage of this design is that we can control for an unforeseen event that happened during our study: because of unexpectedly nice weather in May, the restaurant opened its outdoor serving area on May 9 instead of June 1 as originally planned. The restaurant staff made sure to define different areas of approximately the same size in the outdoor serving area within which to distribute the two different menus. However, the outdoor serving area did not feature any physical border between the two areas.

After the intervention, the control area menu (the one containing the meat and fish options only) was used in the whole restaurant to analyze whether the intervention had any effect after its termination.⁴

3. Data and results

The intervention took place from May 2 until May 20, 2016. During that time, the restaurant did not serve the lunch menu on Ascension Day and the Friday following it, resulting in 13 days of sales data with separate menus. We also collected total weekly sales of the three options for the four weeks before the intervention (April 4–30) and for five days after the intervention (May 22–27). Average sales were around 64 dishes per day during the first five weeks of the experiment (the pre-intervention period and the first week of the intervention) when only the indoor area was open. During the last three weeks of the experiment (two weeks of intervention and one-week post-intervention), the restaurant opened its outdoor seating and sold about 114 dishes per day during the two-hour lunch period.⁵ The complete sales data collected can be found in Appendix Table A.1.

4.1. *The effect of menu design on food choice*

First, we show the aggregate results for the whole restaurant. We conduct chi-squared tests for changes in ordering behavior across the two periods. Figure 1 shows the sales shares of the meat, fish, and vegetarian options for the four weeks before the intervention, the three experimental weeks, and the one-week post-experimental period. On average, only 2.5 percent of all

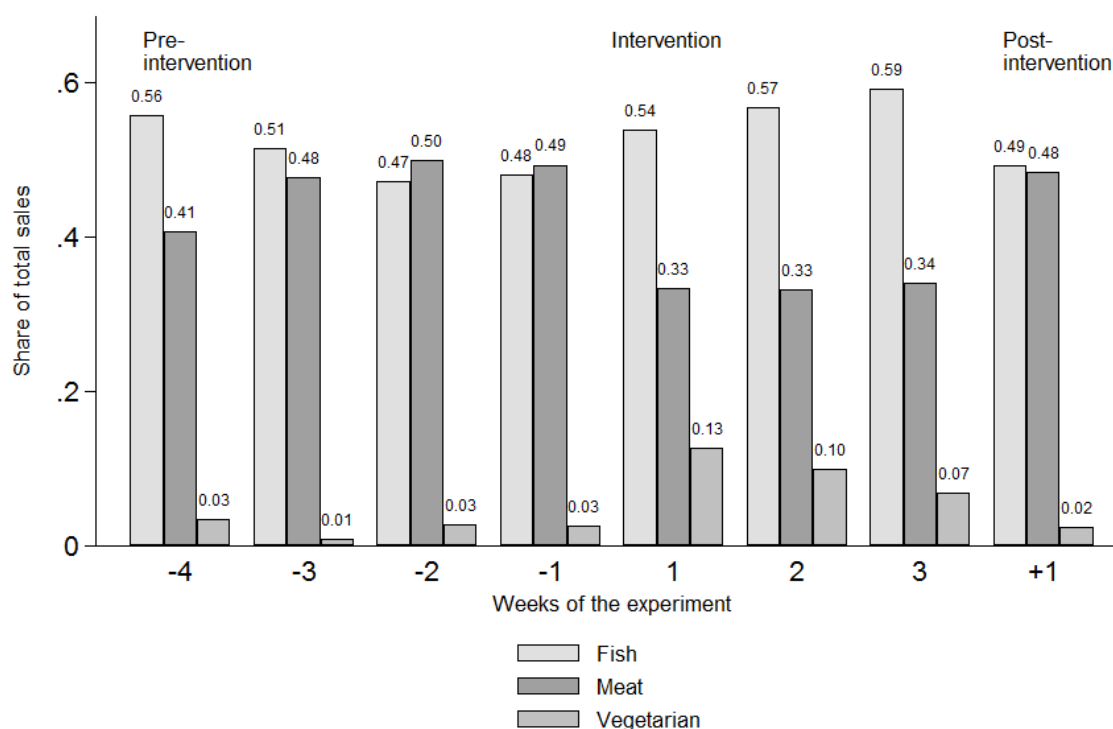
⁴ We recognize the fact that one week is very short for an ex-post period. A longer observation period was impossible, as the lunch menu changed completely on June 1 to the restaurant's summer menu. Consequently, during the eight weeks in which data collection was possible, we collected four weeks of pre-intervention data, three weeks of intervention data, and one week of post-intervention data.

⁵ With the opening of the outdoor serving area, the number of total sales increased considerably starting with the second week of the intervention. However, the shares of the dishes sold in the control area did not significantly change with the opening of the outdoor area. Within the treatment area, the composition of dishes sold changed significantly over the course of the three-week intervention (see Figure 2 and the discussion in section 4.b).

dishes sold were vegetarian without the vegetarian option on the menu.⁶ The remaining lunches sold were distributed approximately equally across the meat and the fish dishes. In the weeks of the intervention (1–3), the share of meat dishes sold overall dropped from 47 to 34 percent on average, a reduction of 38 percent ($p < 0.01$). Especially when considering that only about half of the restaurant was treated, this was a large reduction, and it stayed consistent over the three weeks of the experiment. The vegetarian dishes jumped from 3 to 9 percent on average (a 200 percent increase, $p < 0.01$) but with a downward trend over time. The weekly sales of fish dishes steadily increased during the intervention. On average, the increase was around 8 percentage points, from 50 to 57 percent ($p < 0.01$). A chi-squared test on changes in the overall distribution of meals across the treatment confirms that meal choices differed significantly between the two periods ($p < 0.01$).

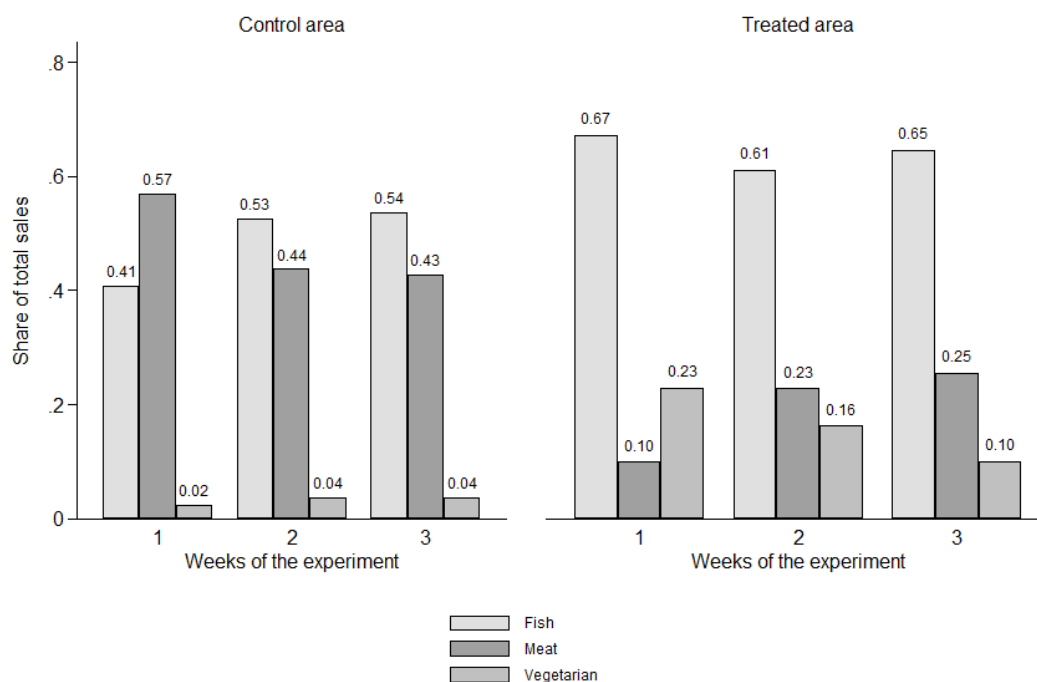
⁶ Based on the development of sales shares especially of the meat and fish dishes during the preintervention period (weeks –4 to –1), we test for a trend in preintervention sales by comparing the distribution of choices on the three options across weeks. A chi-squared test shows that there were no significant changes in the distribution of choices with time ($p = 0.123$). Looking at each dish separately confirms this result (meat: $p = 0.09$; fish: $p = 0.13$; vegetarian: $p = 0.28$).

Figure 1. Shares of total sales, with intervention during weeks 1–3.



Second, we look at the sales for the two menus separately. Because the number of meals sold varies over days and weeks, we show only the percentage of sales in the figures for comparison, but we conduct chi-squared tests using absolute values to test for differences in ordering behavior. All absolute values can be found in Appendix Table A.1. Figure 2 contains the sales shares for the three-week intervention period. The left panel shows the sales for the meat menu and the right panel for the vegetarian menu.

Figure 2. Shares of sales for the two menus separately during the intervention period



When aggregating the data for the three weeks using separate menus, a chi-squared test shows that meal choices differed significantly between the treated and control areas ($p < 0.01$). Of all dishes sold, 15 percent were vegetarian in the vegetarian area, but only 3.5 percent were vegetarian in the meat area ($p < 0.01$). The share of meat dishes sold was 46 percent on average in the meat menu area but less than half of that (21 percent) in the vegetarian menu area ($p < 0.01$). This drop was larger than the increase in vegetarian sales shares, and consequently, the share of fish dishes sold also increased, from 51 to 64 percent ($p < 0.01$). In absolute terms, a little more than 1 out of 10 people who would have chosen meat in the meat area switched to the vegetarian dish in the vegetarian area, and similarly, 1 out of 10 switched to choosing fish. In the meat menu area, adding a statement about the availability of the vegetarian dish did not affect sales significantly. The share of vegetarian dishes sold remained low (between 2 and 4 percent) during the whole intervention. Thus, we conclude that merely providing information

on the availability of a vegetarian dish was not causing the treatment effect. The last three columns in Figure 1 show that switching to the old menu layout, though still keeping the note that a vegetarian dish was available, immediately restored the pretreatment sales shares. Hence, we conclude that the intervention had no lasting effects.

Table 1 shows the marginal effects of having the vegetarian-convenient menu instead of the meat-convenient menu on the three dishes sold estimated via a multinomial logit model. With the multinomial logit model, the probability of choosing each alternative in the two experimental conditions is estimated parametrically, using treatment status as the only explanatory variable. As can be seen in column (1), results confirm the non-parametric results from using chi-squared tests: When looking at the whole experimental period, sales of the vegetarian dish are around 11% higher in the treated area than in the control area, and sales of the meat dish are around 24% lower.

Table 1. Marginal effects of the treatment on the likelihood to consume the following dish, weeks 1-3 of the experiment

	(1)	(2)	(3)	(4)
	Marginal effect,			
	whole treatment pe-	Marginal effect	Marginal effect	Marginal effect
	riod	week 1	week 2	week 3
Meat	-0.243*** (0.024)	-0.470*** (0.052)	-0.209*** (0.037)	-0.173*** (0.041)
Fish	0.127*** (0.026)	0.265*** (0.060)	0.084** (0.040)	0.109*** (0.043)
Vegetarian	0.116*** (0.015)	0.205*** (0.039)	0.125*** (0.024)	0.063*** (0.022)

No of observa-				
tions	1388	254	615	519

Note: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$

As discussed earlier, the restaurant is not only frequented by walk-in patrons, but also by regular customers who visit once or twice a week. As we cannot identify individual customers in our data, it is possible that we include multiple observations of the same person within the three weeks. This would violate the assumption of independent observations that underlies the chi-squared tests, and our p-values would hence be downward biased. The bias should be smaller when looking at weekly effects as we will do in section 3.2. Unfortunately, the structure of our data does not allow controlling for correlation between observations.

A valid concern regarding the experimental setup could be spillover effects between the two areas of the restaurant, especially during the weeks when the outdoor serving area was opened. That could be the case, for example, if customers seated in the meat menu area observed the waiters serving vegetarian dishes to customers in the vegetarian menu area or vice versa, which could influence their choice. Spillover effects could also occur from regular customers who were exposed to one of the menus on one visit to the restaurant and a different menu on another visit. Both types of spillovers would downward-bias our treatment effect. Our results can, therefore, be considered lower bounds of the true effect. Within an area and at the same table, there could also have been reinforcing effects that were captured by the treatment effect. If the first person was nudged to choose either the meat or the vegetarian dish, then others at the table might follow suit or else deliberately deviate from that choice to create variety. In a study with children, Angelucci et al. (2015) find reinforcing choices, but in a study with adults in a restaurant, Ariely and Levav (2000) present evidence for a love of variety in group choices. Since we have no information on the sequence in which orders were placed, we cannot identify such peer effects.

One point often raised when discussing nudging toward vegetarian food is that customers might not feel satiated or might use the healthy main course as an excuse to order an unhealthy dessert. We examined the number of desserts ordered for both groups, but as the total number of desserts ordered was very low (≤ 6 per day), it was not possible to test this hypothesis. Compared with the pre-experimental period, the total sales of desserts did not increase. The menu price included water, which is what most Scandinavians drink for lunch. There was no change for any additional beverages ordered during the experimental period. We thus find no evidence for any compensational behavior in our data. We cannot, however, rule out that individuals may have compensated in the afternoon or evening by eating more meat or making other unhealthy food choices.

4.2. Development of the treatment effect over time

Figure 2 shows that there was a decrease in the treatment effect over time. In the treated area, the share of vegetarian dishes goes down from 23 percent during the first week to 10 percent during week three, while the share of meat dishes sold increases. While treatment effects are statistically significant when comparing the treated and the control areas separately for each week (chi-squared tests, $p < 0.01$ for each week), a chi-squared test shows that the distribution of choices changed significantly over the three weeks of the intervention within the treated area ($p < 0.01$).⁷ Testing specifically for differences in the sales of vegetarian dishes per week shows that all weeks differ significantly from each other at least at a 10 percent level of significance (week 1 versus week 2: $p < 0.01$; week 1 versus week 3: $p < 0.01$; week 2 versus week 3: $p = 0.10$). In the control area, no significant changes occurred during the intervention period.⁸ Estimating the treatment effects separately for each week via a multinomial logit regression

⁷ It should be again noted that multiple observations of the same person within a week would downward bias the p-values. However, the potential bias should be smaller when analyzing treatment effects per week than when aggregating the data across periods, as regular customers, according to the staff, visit once or twice a week.

⁸ This holds when looking both at all three choices simultaneously and at only the share of vegetarian dishes sold.

shows that the size of the treatment effect decreases for the vegetarian dish from around 21% in week 1 to 13% in week 2 and 6% in week 3 of the experiment (columns (2) to (4) in Table 1). Correspondingly, the absolute size of treatment effect for meat falls from -47% in week 1 to -21% week 2 and to -17% in week 3. What could have caused this trend in the treatment effect? There are several potential explanations for the decline we observe. All walk-in customers should be equally affected by the nudge, whether they visited the restaurant in week one, two, or three of the experiment. Thus, although the decline of the treatment effect over the course of the experiment is quite pronounced, we do not expect it to fade away completely if we had kept the nudge in place for a longer period. However, in connection with the opening of the outdoor seating area, the composition of customers might have changed. Customers who visited during the last two weeks could have differed from customers who visited during the first week and may have reacted less to the nudge.⁹

Another explanation for the decline in the treatment effect could be that the staff got less careful in implementing the experimental design, especially in connection with the opening of the outdoor seating, such as by handing out control menus erroneously in the treated area and vice versa. To the best of our knowledge, however, this was not the case. Any changes in the implementation of the experiment should also have shown up in the control area, but as discussed above, sales patterns concerning the vegetarian dish did not change over time in the control area.

A third explanation is the presence of regular customers who had experience with the pre-intervention menu. The restaurant reports having a high number of regular customers, around 20 percent. For the first three days of the intervention, we have data on the choices of customers

⁹ There is a theoretical possibility that the customer composition changed as a result of the nudge, such as if people recommended or did not recommend that others visit the restaurant after having eaten there while the nudge was in place, and this in turn could have influenced how effective our treatment was. However, such indirect effects are hard to quantify within a given time frame, but such changes in customer composition should also have shown up in the control area.

who were identified by the waiters as regulars; 52 out of a total of 254 guests during the first week belong to that group.¹⁰ Although the data are limited, they paint a clear picture. Of the 23 regulars exposed to the vegetarian menu, 17 ordered fish, 6 ordered the vegetarian dish, and none ordered meat. Of the 29 regulars exposed to the meat menu, 17 ordered fish, 12 ordered the meat, and none ordered the vegetarian option. The shares match the total sales shares of that week. These customers all had experience with the previous menu featuring a choice of meat or fish and had likely tried both types of dishes at some point. One can also assume that because they are regulars, the meat and fish dishes correspond well to their preferences; that is, those customers are regulars because they like the dishes usually featured on the menu.

For those customers, a change in saliency of the dishes and a disruption of habits seems to be the most likely explanation for the initial treatment effect. However, as Wood and Neal (2009) explain, people can revert to their habitual behavior relatively easy after a deviation to an alternative behavior. Giving in to the nudge in the first place but reverting to familiar (and preferred) choices afterward could generate the declining treatment effect we can observe in Figure 2. As we do not have any follow-up data on this group and do not know anything about the behavior of regulars who visited the restaurant more than once during our experiment, we cannot draw firm conclusions on this point. More detailed information and long-term data on regulars are needed to investigate this interesting subgroup further.

Our finding that experienced users change their behavior, at least initially, is in contrast to Löfgren et al. (2012), who show that experienced users are harder to nudge and override defaults more often than inexperienced users in an experiment using default settings. Our results show that even experienced users change their behavior, at least initially. However, the decision in our experiment, choosing lunch at a regularly visited restaurant, is different from the one studied by Löfgren and colleagues, where the intervention targeted carbon offsetting from

¹⁰ We only know the total number of regular guests that week, not the number of distinct individuals. Hence, we cannot rule out that some of the regulars visited the restaurant more than once during the three days it was open.

flights. Choosing a lunch involves lower stakes and is a frequently repeated action for the regulars. Thus it will most likely be dominated by the intuitive, fast system and will be more responsive to the nudge. Another explanation of the difference in findings could be that regret from trying something new as a result of a nudge will likely be lower in the case of choosing lunch than in the higher-stakes, low-frequency case.

4. Discussion and Conclusion

We show that a simple and inexpensive rearrangement of the menu that changes the convenience of ordering meat contributes toward a reduction in meat consumption without measurable negative effects.¹¹ Making it less convenient to order meat significantly increased the shares of both vegetarian dishes and fish dishes sold. From a climate change perspective, this is still a positive change, as eating fish entails less climate-relevant emissions per kilogram (kg) than most kinds of meat (Röös, 2014).¹²

How much of a climate impact did the intervention have? A brief example can put it into perspective. On one occasion, the meat dish included a piece of beef, while the vegetarian option was grilled cabbage. A conservative estimate of the CO₂ emissions of a 150 g piece of Swedish beef is 4 kg (Röös, 2014). For the cabbage, it is 0.03 kg. That day, 42 percent of customers exposed to the meat menu ordered the beef, but only 16 percent of those presented with the vegetarian menu did so. With roughly 50 people in each group, that amounted to 84 kg of CO₂ from meat in the meat menu group but only 32 kg from meat in the vegetarian menu

¹¹ Anecdotally, no customers complained about the food during the experimental period. If someone noticed a change in the menu, the staff explained that they were trying out some new dishes, and all customers accepted this explanation. Since the sales data is dependent on weekday and weather, we cannot reliably test whether the intervention had an effect on sales, as sales only increased over time. We cannot rule out that customers who tried the vegetarian option and did not like it decided not to come back to the restaurant. We can, however, say that as a result of the experiment, restaurant management decided to push the vegetarian menu more (i.e., they do not expect negative returns from selling more vegetarian dishes). As mentioned above, we do know that no one left the restaurant after looking at the menu.

¹² Consuming fish entails less climate-relevant emissions than beef, lamb, pork, and mixed meats (such as minced meat) and approximately as much as chicken.

group. To put this into perspective, average emissions from driving a car in Sweden are around 0.16 kg of CO₂ per kilometer. Both the reduction in CO₂ and the cost differential for the restaurant varies depending on the type of meat, and vegetarian substitute served. Another day, the meat dish was grilled chicken, while the vegetarian menu featured tofu. Chicken and soy substitutes such as tofu entail approximately the same amount of climate-relevant emissions per kg (Röös, 2014). Any overall evaluation of climate benefits also crucially depends on the assumption that customers do not compensate for having chosen a vegetarian lunch by indulging in meat later that day or the day after. Complete information about food choices is quite challenging to obtain, and to the best of our knowledge, no experiment has yet been conducted that examines substitution effects over time. More research in that area is needed to identify total climate effects of nudges aiming at reducing meat consumption.

We conclude that even in restaurants with an initially low share of vegetarian customers, there is room to decrease the share of meat dishes sold in favor of vegetarian and fish dishes without banning options or changing prices, and this can be done in a fast, easy, and profitable way. According to the restaurant's management, purchasing costs are around 30 percent lower for vegetarian than for meat dishes, while personnel costs are slightly higher as the preparation of vegetarian dishes is slightly more time-consuming. However, taking all costs into account, it is not more expensive to produce vegetarian dishes than meat or fish dishes. A higher share of vegetarian dishes could also bring down the marginal personnel costs. Overall, the restaurant's management deemed the intervention to have had positive effects on profits but could not quantify the magnitude of this effect.

We find that around two out of ten customers who would have chosen meat switched to either vegetarian or fish dishes. Validating the effect size in other settings would be interesting. Restaurants that either cater to vegetarians or are meat-focused venues such as steakhouses will most likely see smaller effects from the same kind of intervention due to self-selection of the

patrons into the restaurant. The most promising settings are restaurants that attract customers based on their quality of food and not on their focus on serving meat or vegetarian food. In our sample, one out of ten people would switch from meat to vegetarian food if it is made convenient and salient. Restaurants should not present vegetarian food as a special diet that customers need to inquire about, as this creates hassle costs that will tip people on the margin toward choosing the “normal” meat dish instead.

The shift to vegetarian food was strongest in the first week of the intervention. A conservative interpretation of this result leads to the conclusion that the nudge might work best in a setting with a lower share of regular customers so that more people experience the nudge as new. The observed decrease in the treatment effect over the course of the intervention shows the need for more research on the impact of nudges over time to formulate recommendations on long-term strategies.

The sizable results in our experiment are a promising first step for further research on how to effectively reduce meat consumption. Although we cannot rule out any negative spillover effects on profits, our evidence points toward the contrary, with stable sales and higher profit, especially when comparing our intervention with a reduction of choice by banning the meat option, which would most certainly keep guests from eating at this restaurant. Nevertheless, more research is needed to verify these hypotheses. Public or private sector agents that want to limit the climate impact of food consumption should work proactively with restaurants to develop, implement, and test customized nudging strategies to realize the potential gains from this approach.

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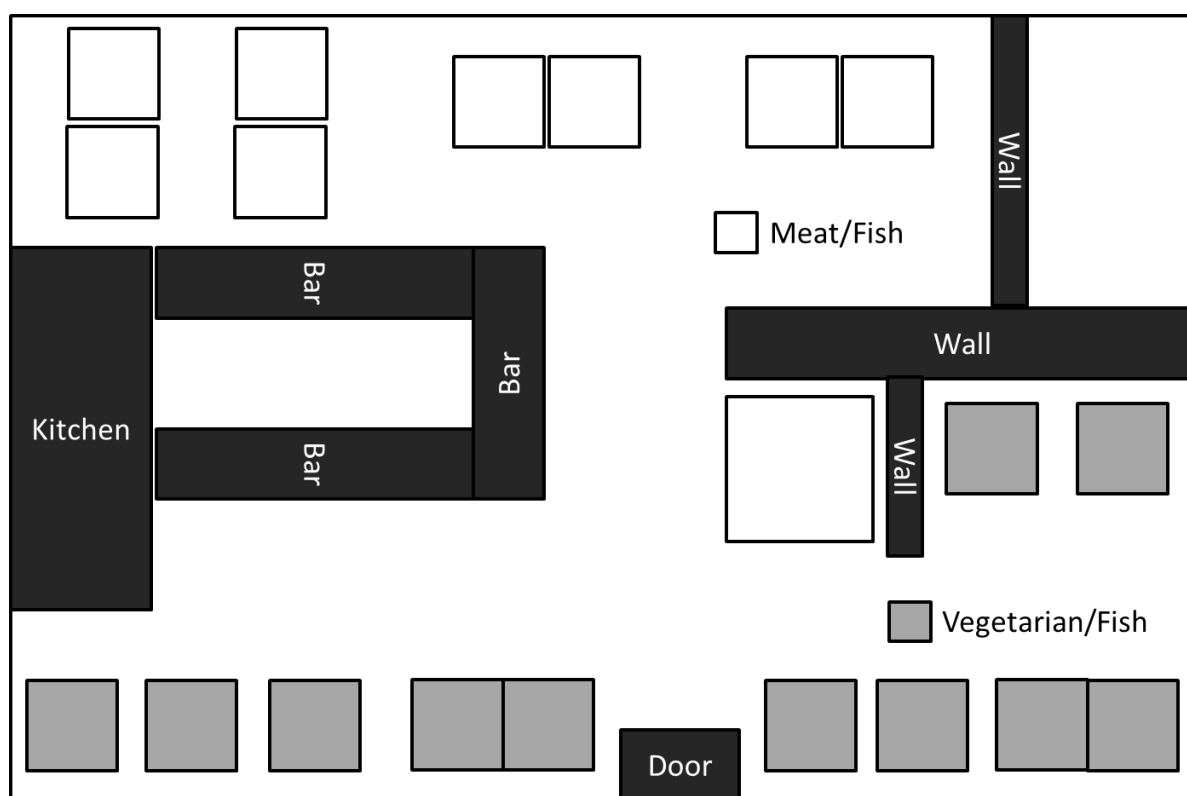
Appendix

Table A.1. Total sales and sales shares in percentages of the three lunch options available across periods and treatments

		Meat		Fish		Vegetarian		Total sales	
<i>Convenient option to order^a</i>		<i>Meat</i>	<i>Veg</i>	<i>Meat</i>	<i>Veg</i>	<i>Meat</i>	<i>Veg</i>	<i>Meat</i>	<i>Veg</i>
Baseline period	Week 1	119		163		10		292	
		40.75%		55.82%		3.42%		100%	
	Week 2	113		122		2		237	
		47.68%		51.48%		0.84%		100%	
	Week 3	160		151		9		320	
		50.00%		47.19%		2.81%		100%	
	Week 4	187		182		10		379	
		49.34%		48.02%		2.64%		100%	
Total		579		618		31		1,228	
		47.15%		50.33%		2.52%		100%	
Average sales/day		29		30.9		1.6		61.4	
Intervention	Week 1 (3 days)	70	13	50	88	3	30	123	131
		56.91%	9.92%	40.65%	67.18%	2.44%	22.90%	100%	100%
	Week 2	142	66	171	177	12	47	325	290
		43.69%	22.76%	52.62%	61.03%	3.69%	16.21%	100%	100%
	Week 3	106	69	133	175	9	27	248	271
		42.74%	25.46%	53.63%	64.58%	3.63%	9.96%	100%	100%
	Total	318	148	354	440	24	104	696	692
		45.69%	21.39%	50.86%	63.58%	3.45%	15.03%	100%	100%
Average sales/day		24.5	11.4	27.2	33.8	1.8	8.0	53.5	53.2
Postintervention	Total (5 days)	285		280		14		579	
		49.22%		48.36%		2.42%		100%	
	Average sales/day	57		56		2.8		115.8	

^a The fish option was equally convenient to order across periods and treatments and is therefore omitted here.

Figure A.1. Layout of the restaurant



Note: Dark grey squares are tables with the vegetarian/fish menu, and white squares are tables with the meat/fish menu.

Figure A.2. Examples of the Meat/Fish and Vegetarian/Fish Menus

Meat/Fish	Vegetarian/Fish
<p>Torsdag</p> <p>Bakat lammlägg med pumpasallad, getost och aubergineris</p> <p>Chillibakad kolja "Loose aioli" med bakad svamp, lotusrot och pak soi</p> <p>Fredag</p> <p>Sotad biff med refried beans, fetaost, rödkål och stekt sallad</p> <p>Panerad spätta med relish "delish" aioli, libabröd och pickles</p> <p><i>Chokladtryffel eller en kula sorbet 35sek</i></p> <p>Vi har även vegetariskt alternativ.</p> <p><i>Lunchen kostar 110sek och då ingår en plocktallrik, ekologisk surdegsgalette samt stilla vatten.</i></p>	<p>Torsdag</p> <p>Kryddbakad pumpa med cruditee, aubergineris och getost</p> <p>Chillibakad kolja "Loose aioli" med bakad svamp, lotusrot och pak soi</p> <p>Fredag</p> <p>Grillad kål "Rosé" med refried beans, fetaost och stekt sallad</p> <p>Panerad spätta med relish "delish" aioli, libabröd och pickles</p> <p><i>Chokladtryffel eller en kula sorbet 35sek</i></p> <p>Vi har även kött alternativ.</p> <p><i>Lunchen kostar 110sek och då ingår en plocktallrik, ekologisk surdegsgalette samt stilla vatten.</i></p>

Note: The boxes around the dishes and around the additional sentence were not on the menu but have been added by the authors to aid the reader.